TETRA TECH

URGWOM 2016:

A Generalized Timestep Ruleset for URGWOM

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URGWOM User's Group Meeting
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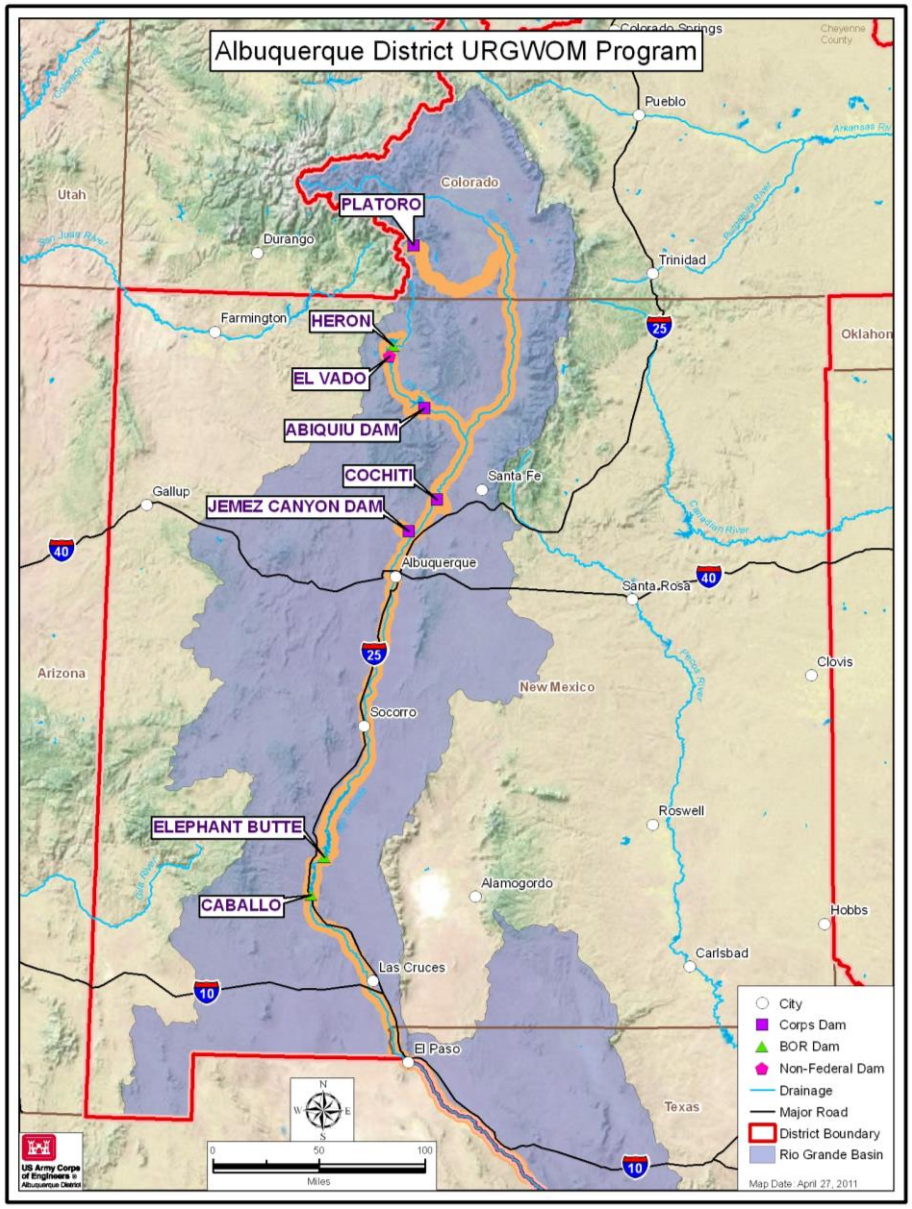
Boulder

URGWOM: Overview of Current Status



Upper Rio Grande Water Operations Model:

Headwaters to Hudspeth, Texas

One RiverWare model file with separate daily and monthly rule-sets which can be used for a variety of applications:

1. Daily, data driven accounting of native and trans-basin (Colorado River) water in the system. (Typically run daily by Reclamation)

2. Daily or monthly timestep annual operating plan runs. (Typically run 2-3 times per year by USACE.)

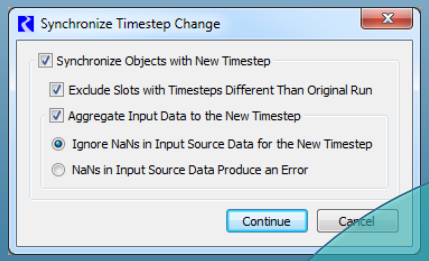
3. Daily or monthly timestep planning runs. (Run as planning needs demand and funding resources allow by Reclamation, USACE, or NMISC.)

4. (A combination of 1 and 2 or 1 and 3, going from data driven accounting to rule driven operations where historic data ends.)

URGWOM: Daily to Monthly

RiverWare Changes

- Data Aggregation ✓
- Simulation Methods ✓
- Object Level Accounting Methods ✓



URGWOM Base Changes

- Rules Generalization
  - Initialization ✓
  - Expression Slot ✓
  - Utility Groups ✓
  - Policy Groups ✓
- Routing lags ✓
- GW Parameters
- Table series slots ✓

Changes for Automated Conversion

- Set routing methods & gw parameters using a script ✓
- Table series slots rework ✓

The goal:
URGWOM daily to URGWOM monthly with a few mouse clicks

URGWOM daily to monthly

- Input Data Aggregation
  - Series Slots
  - Table Series Slots*
- Remove Lags
- GW-SW Interactions
- Rules
  - Initialization Rules Set
  - Expression Slot Logic
  - Policy Rules Set**

Automated by RiverWare

Automated by scripts

Model specific. Generalized rules and functions have been developed to function at a daily or monthly timestep

Distinct policy rule sets for each model

* RiverWare object level accounting methods using Table Series Slots have been modified to allow automated aggregation starting with RiverWare 7.0

** Development decision to have two separate rule sets

One Rule-Set or Two

Depends on how often a *consistent* monthly model needed

Two Rule-Sets

+ Don't complicate daily rules with monthly logic
+ Only update monthly rules as needed
- Updated monthly model elusive/expensive

One Rule-Set

+ Consistent model always available
- More difficult to write?
- Constant development & upkeep

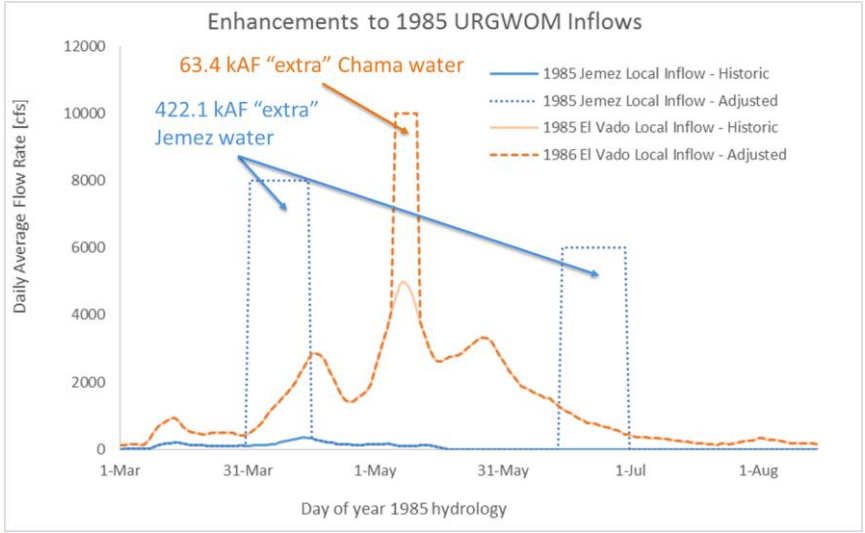
rarely ← relative frequency of monthly model need → regularly

URGWOM technical team decided on two rule sets

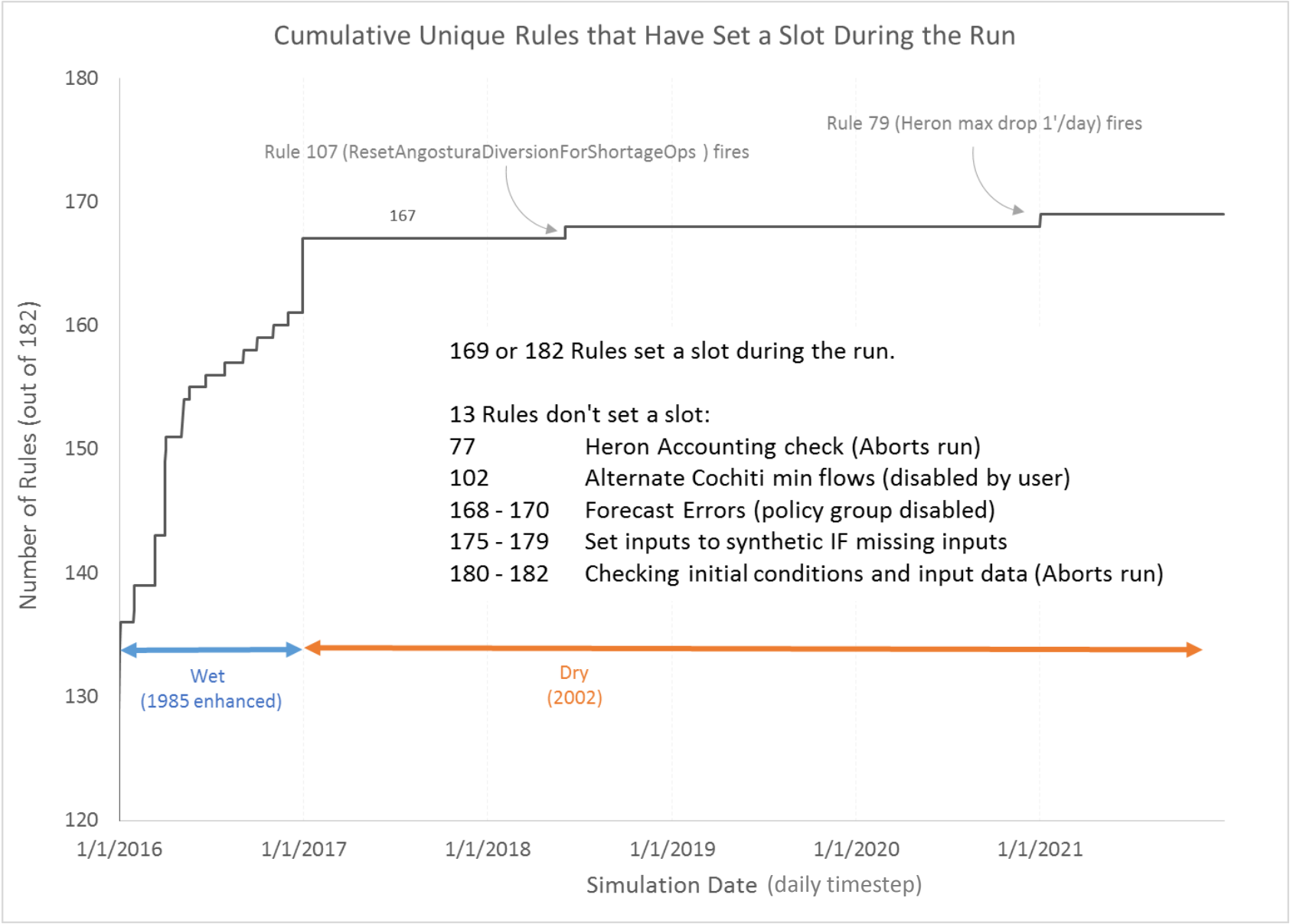
(However initial monthly ruleset developed by generalizing daily ruleset.)

URGWOM monthly policy rule set

- Develop test sequence
  - Goal: Create a model run that exercises as many rules as possible as quickly as possible.
  - All "results impacting" rules fire in daily model by starting with (over)full reservoirs, and a year of "enhanced 1985" (wet) hydrology followed by 5 years of 2002 (dry) hydrology.
  - "Enhanced 1985" hydrology is 1985 historic with ~500 KAF added inflow to Jemez & El Vado to increase runoff peak.



URGWOM Rule Set Test Sequence



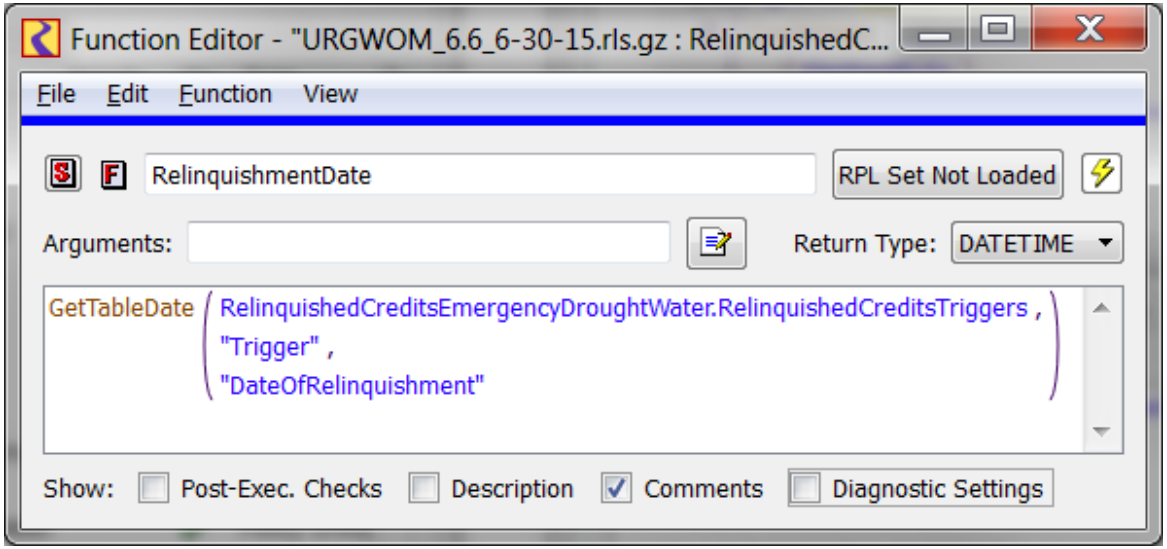
Examples of Generalizing Ruleset Functions

Name	Input	Return Type	Replaces daily specific code:
EndOfPrevYear()	None	Datetime	24:00, December 31, @“Previous Year”
FirstTimestepOfYear()	None	Datetime	January 1 Current Year
IsFirstTimestepOfYear()	None	Boolean	@“t” == January 1 Current Year
RoundDateToTimestepEnd(@“t”)	Datetime	Datetime	Lookup in tables, or any reference to a specific date.
PreviousTimestep(@”t”)	Datetime	Datetime	@“t” – 1“day”
RoundDurationToTimestep(x)	Numeric w units of time	Numeric integer no units	t+1 where 1 refers to days can be written as DatePlusNTimesteps(@“t”, RoundDurationToTimestep(1”day”)).
DatePlusNTimesteps(@“t”,N)	Datetime, Integer	Datetime	Used with RoundDurationToTimestep to generalize t+1 type statements where the 1 is days not timesteps

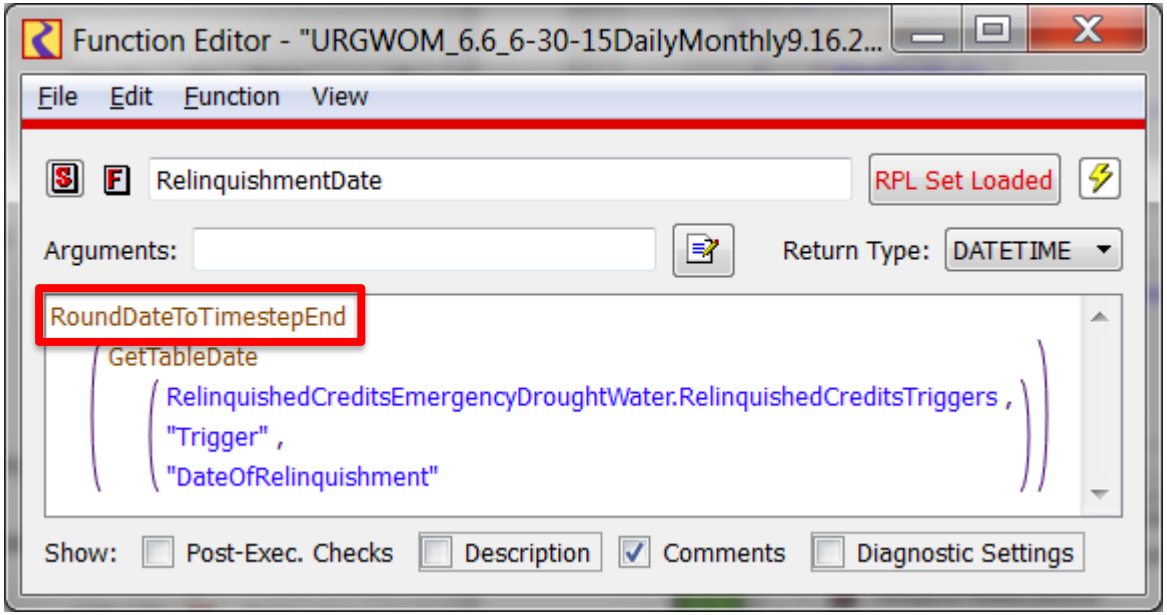
URGWOM Monthly Rule Set

- Code generalization examples:

Daily:



Either (general):

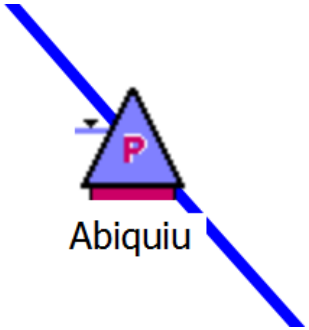


t – 1 Ambiguity

- When a modeler uses “t-1” it may refer to either
  - Previous timestep

    This is typical with reservoir storage related logic and really means storage at the beginning of the current timestep. Inherently general

    Or…



  - Current timestep less the amount of time represented by the timestep

    This is common when dealing with flow lags.

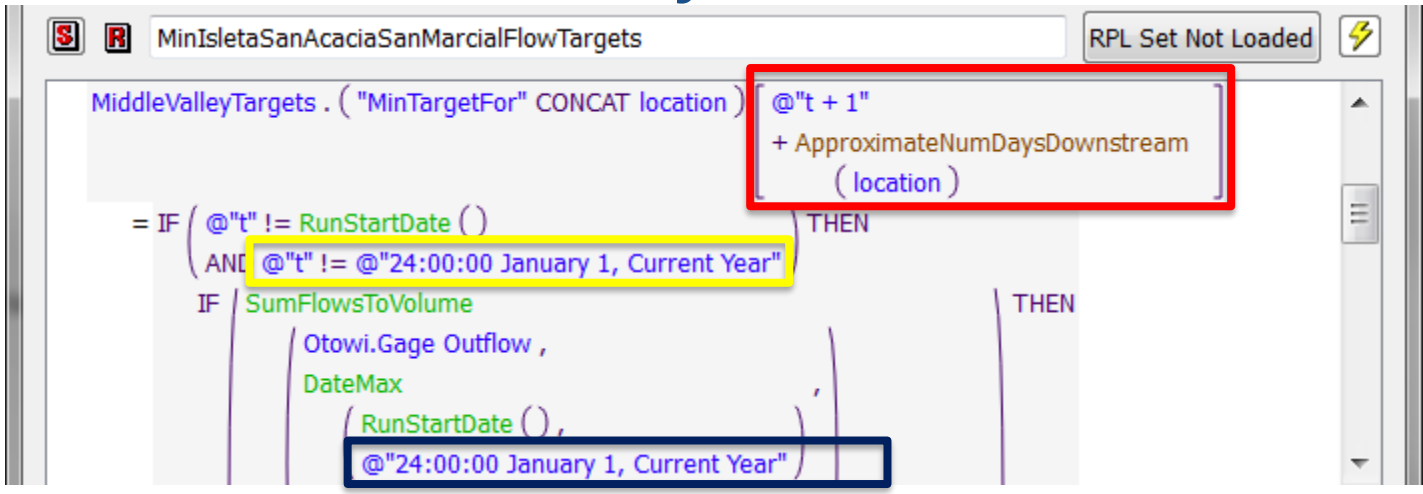
    Generalize by using new functions:

    “DatePlusNTimesteps(@“t”, RoundDurationToTimestep(-1 “day”))

URGWOM Monthly Rule Set

- Code generalization examples:

Daily:



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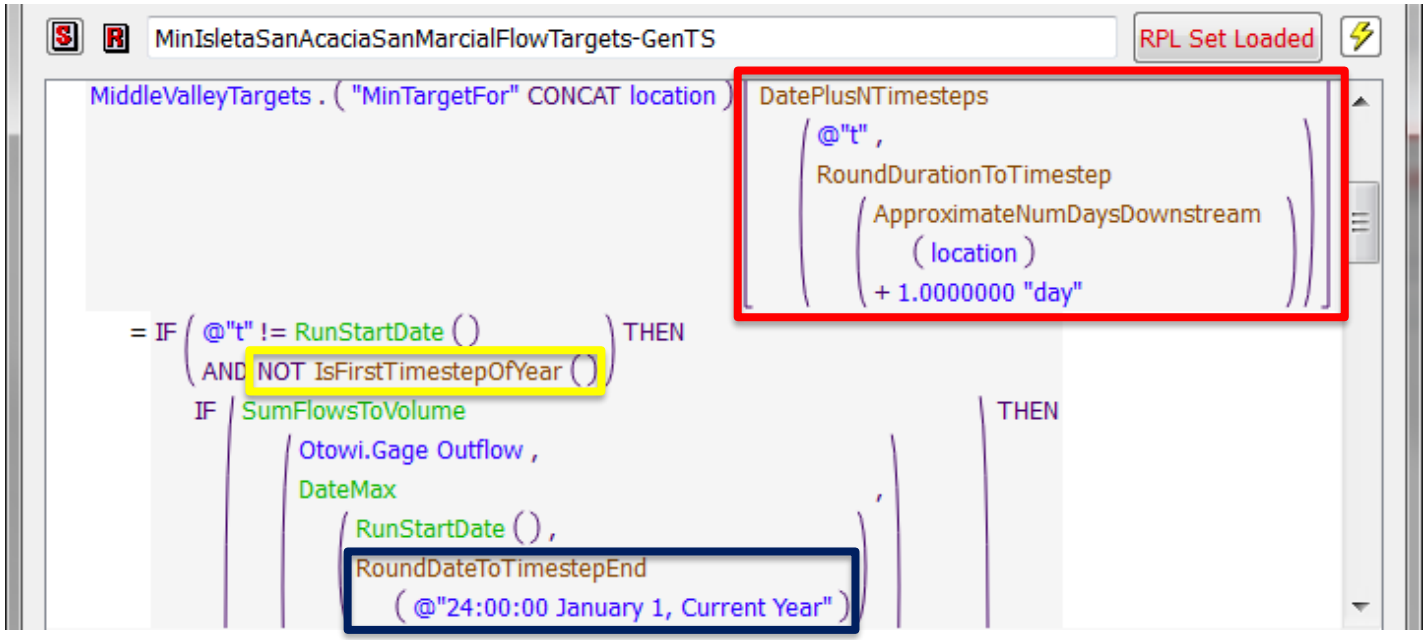
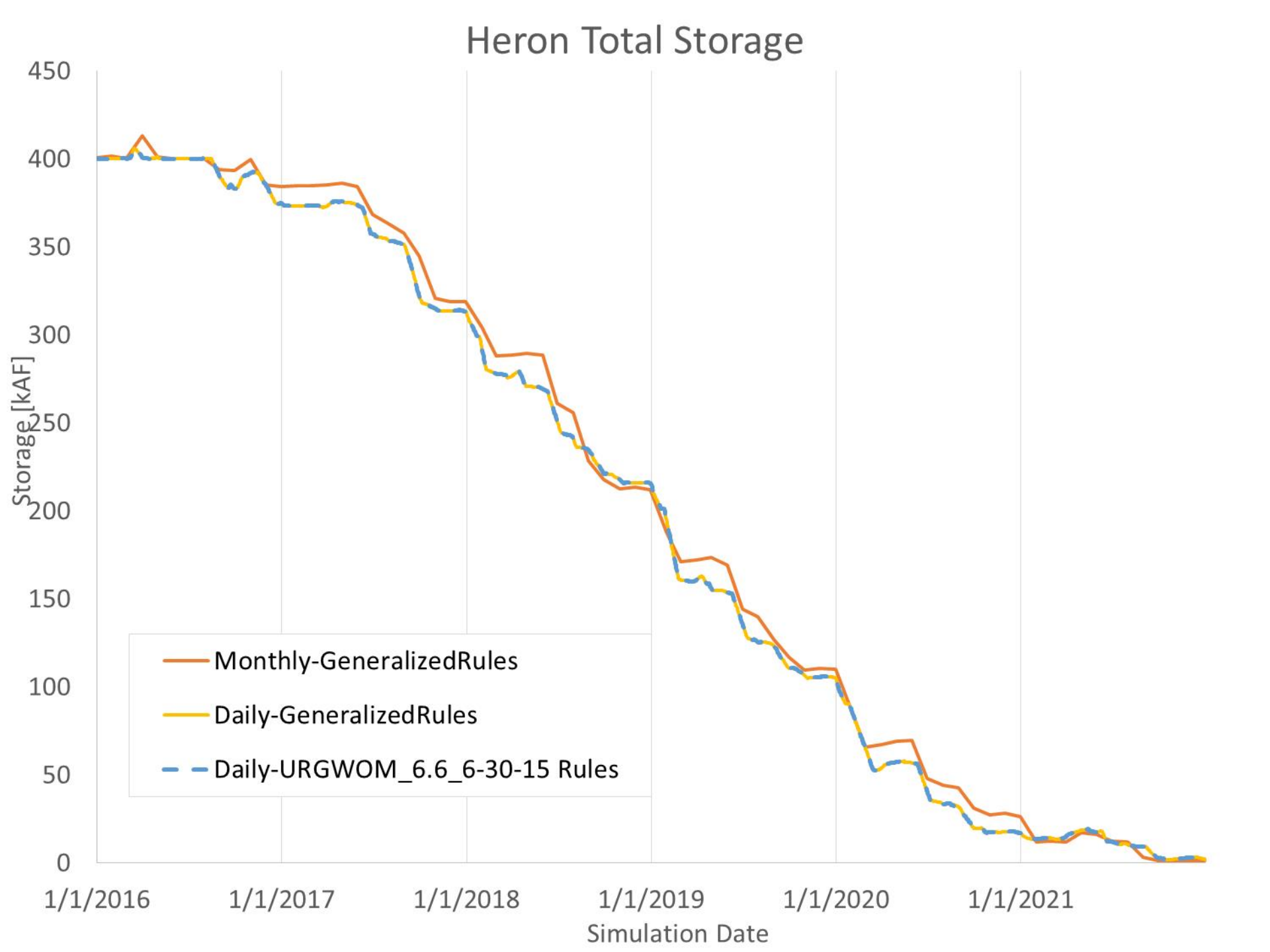


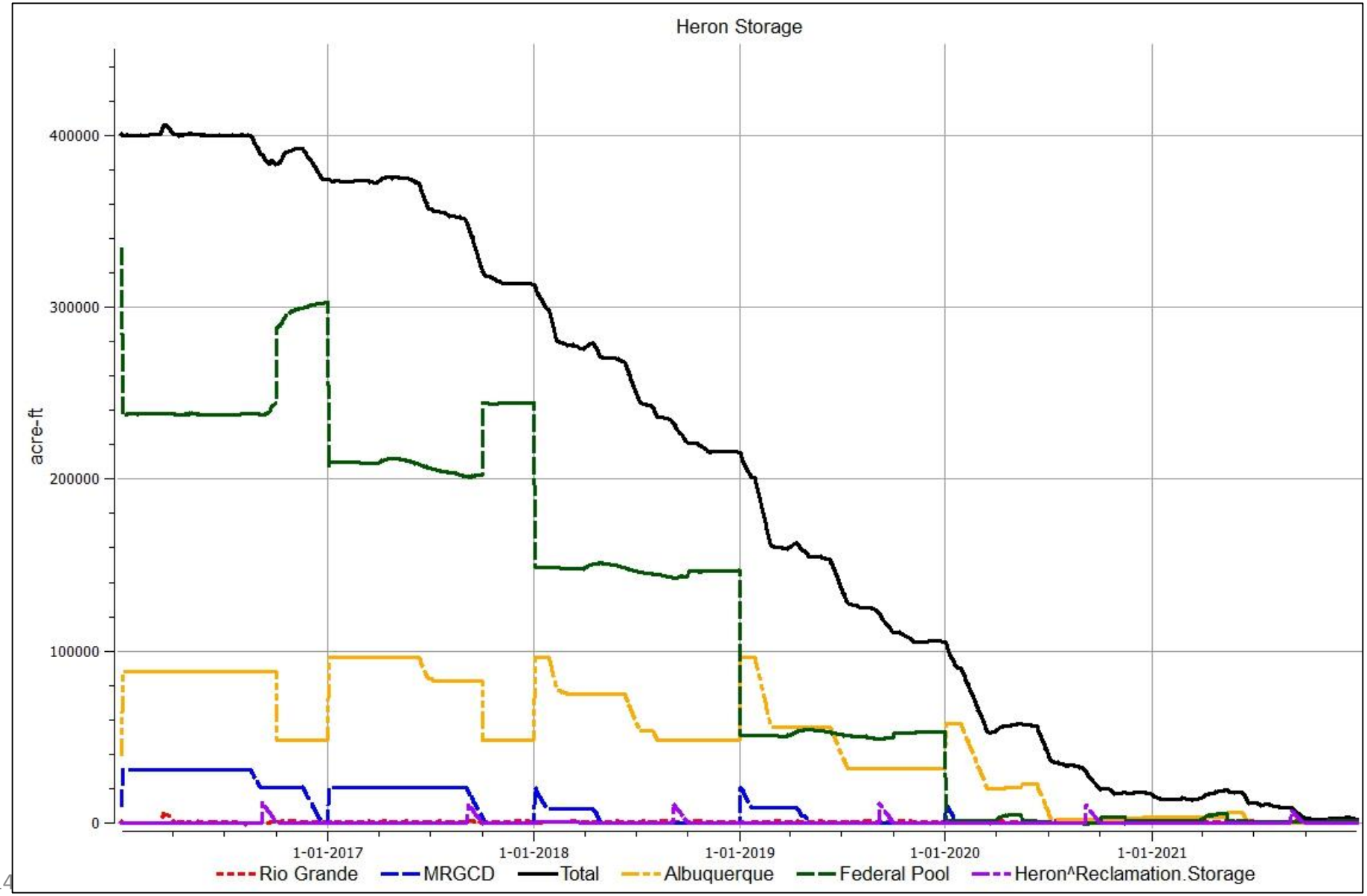
Ruleset Changes Summary

- Summary of changes:

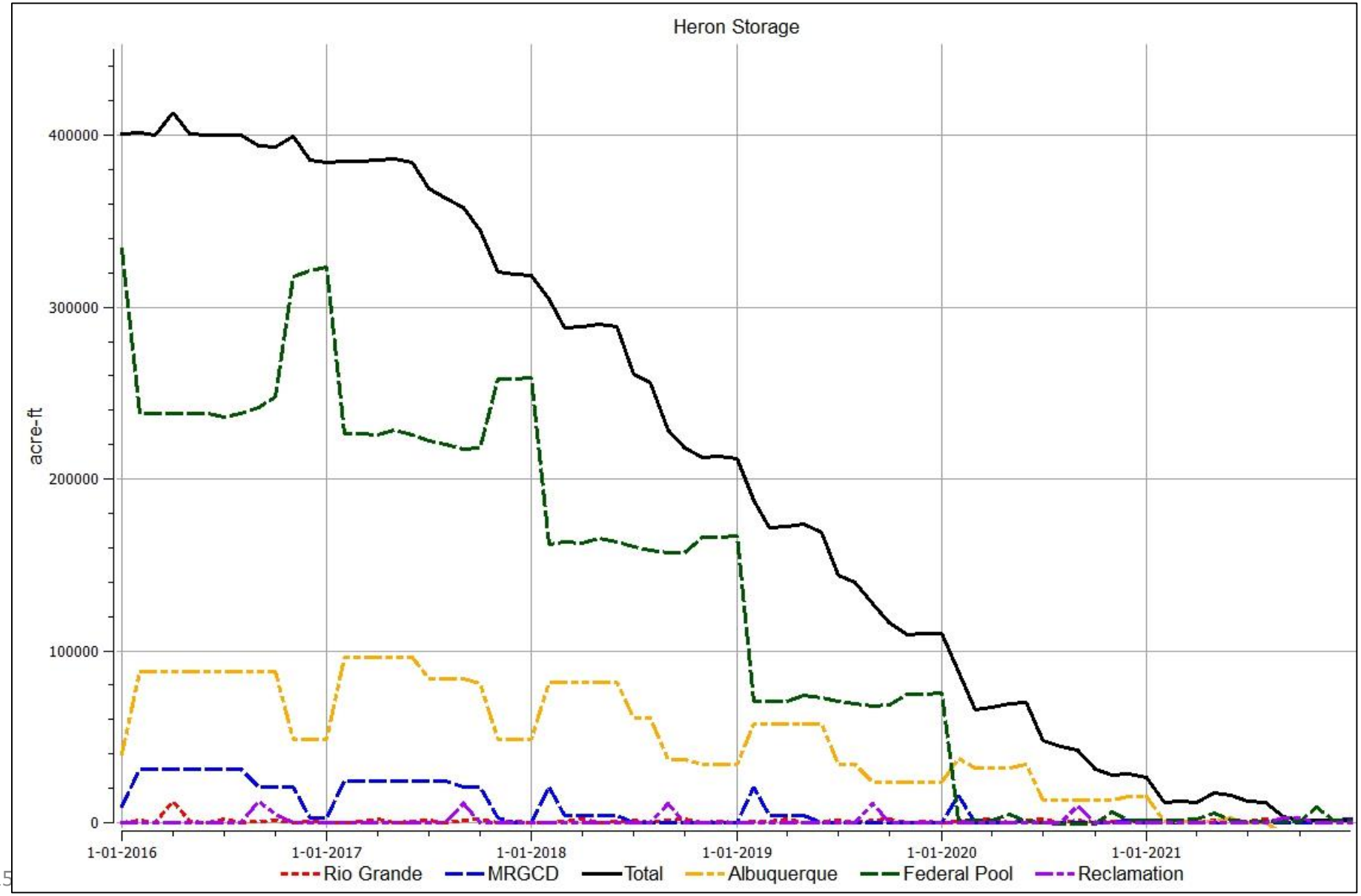
	Expression Slot Functions Set	Initialization Ruleset	Policy Ruleset
Modified Functions	2 (of 45)	2 (of ~ 200)	67 (of 469)
New Functions	3 (of 45)	2 (of ~ 200)	29 (of 469)
Modified Rules		1 (of 74)	54 (of 180)
New Rules		0 (of 74)	2 (Split old rule)
Rule Order Changes			2 policy groups
Objects Generalized	49		

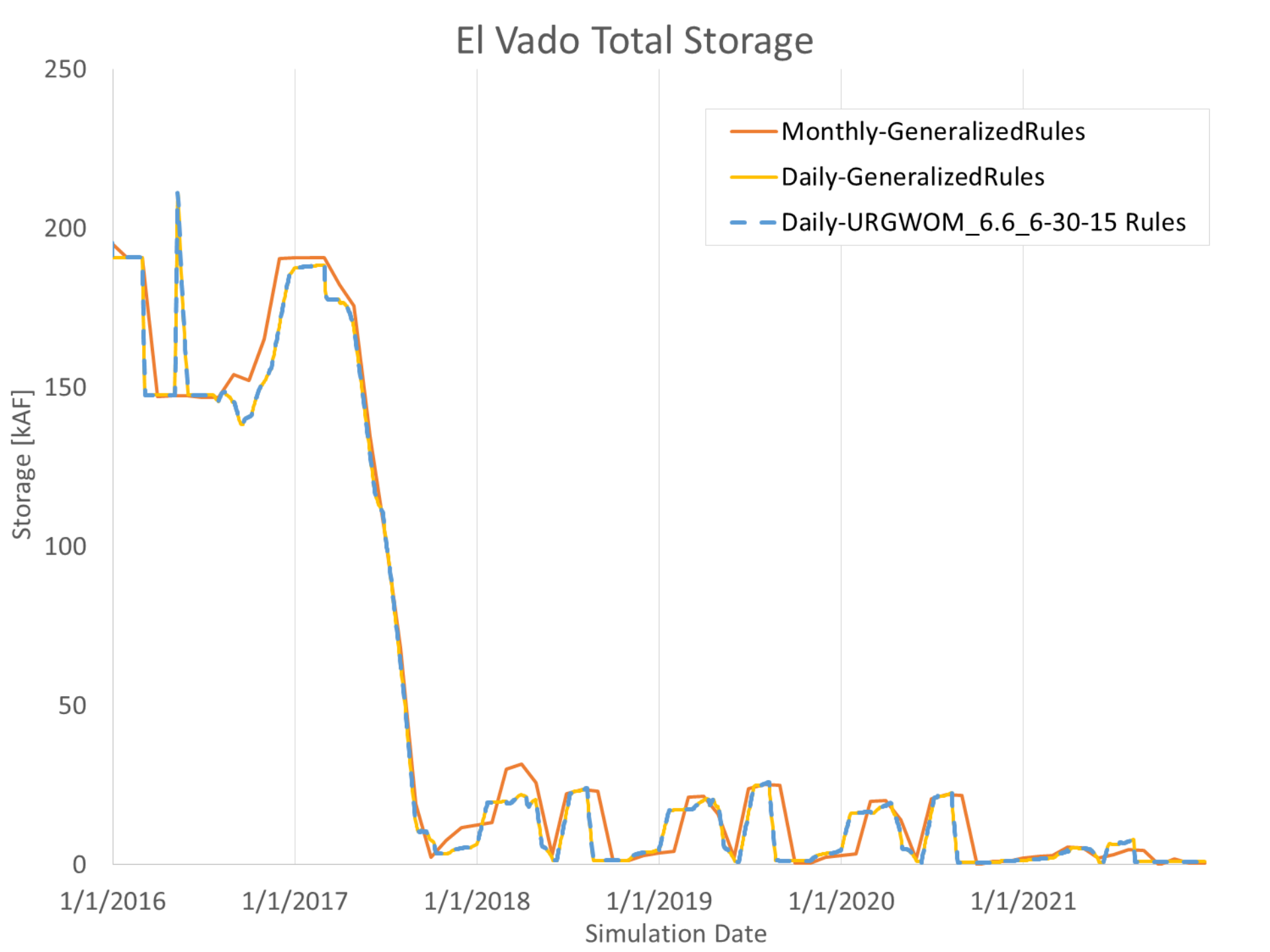

Heron Total Storage
450
400
350
300
250
200
150
100
50
0
Storage [kAF]
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021
Simulation Date
Monthly-GeneralizedRules
Daily-GeneralizedRules
Daily-URGWOM_6.6_6-30-15 Rules

Heron Storage – Major Accounts – Daily

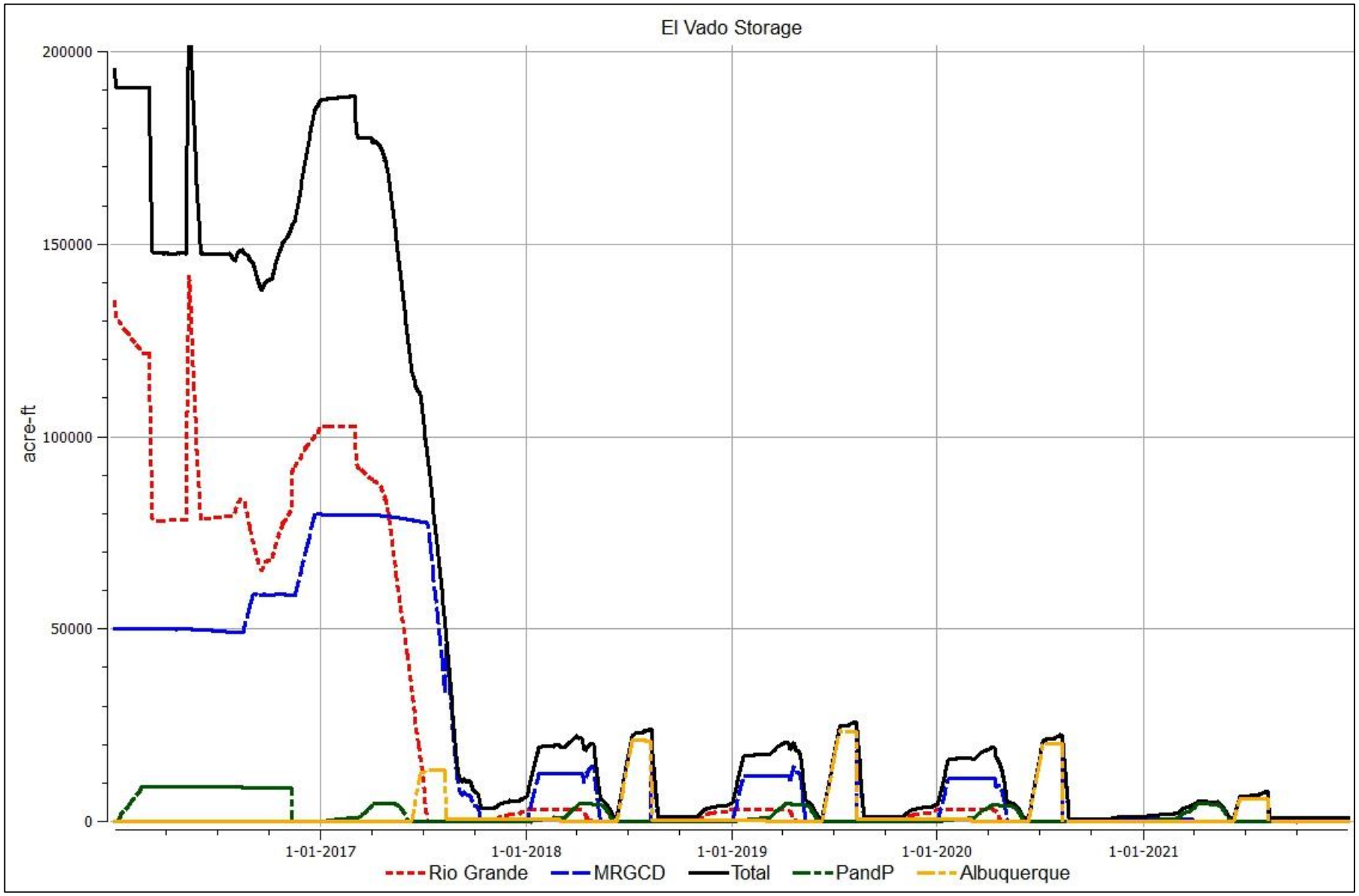


Heron Storage – Major Accounts – Monthly

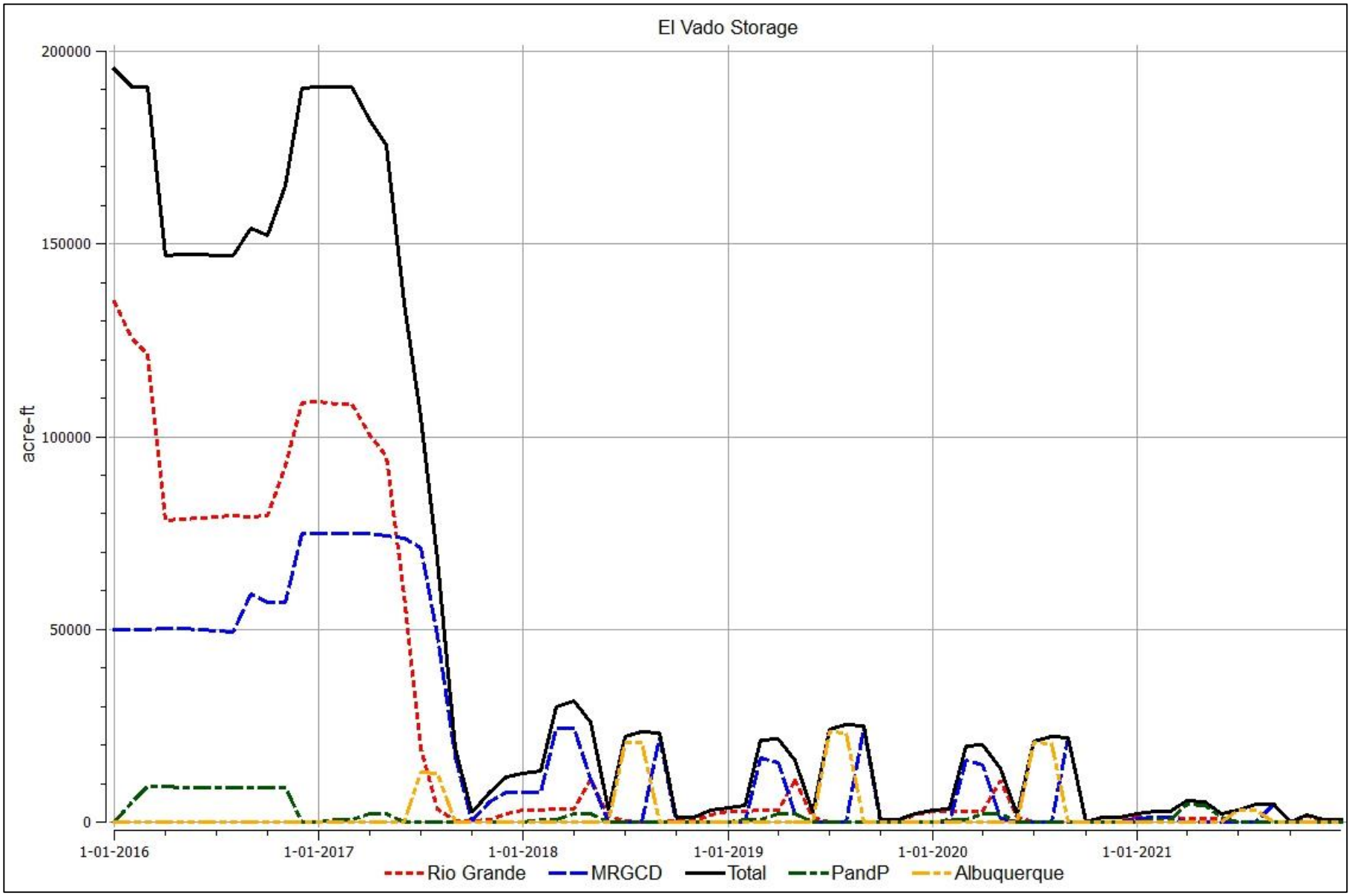


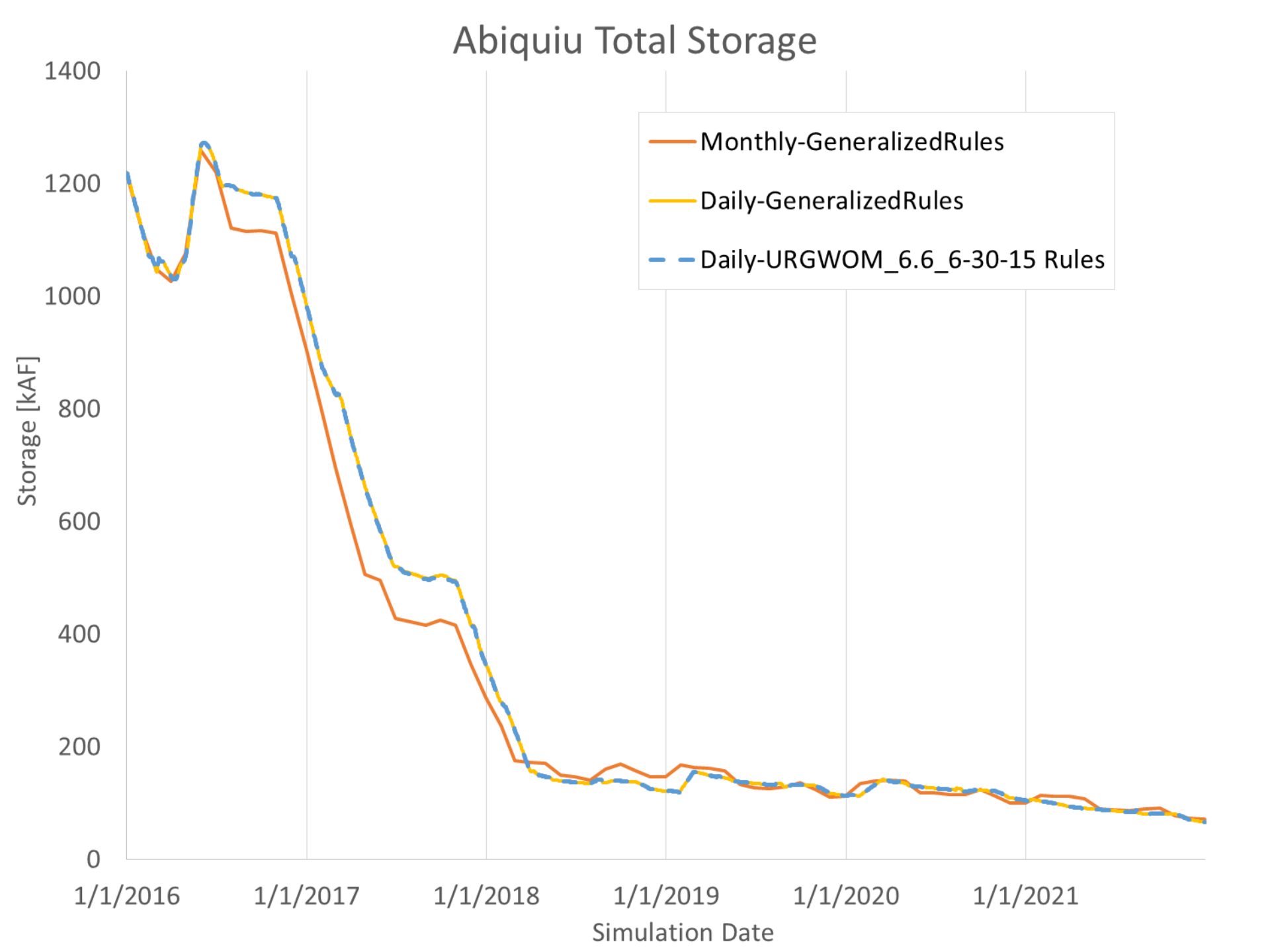

El Vado Total Storage
250
200
150
100
50
0
Storage [kAF]
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021
Simulation Date
Monthly-GeneralizedRules
Daily-GeneralizedRules
Daily-URGWOM_6.6_6-30-15 Rules

El Vado Storage – Major Accounts – Daily

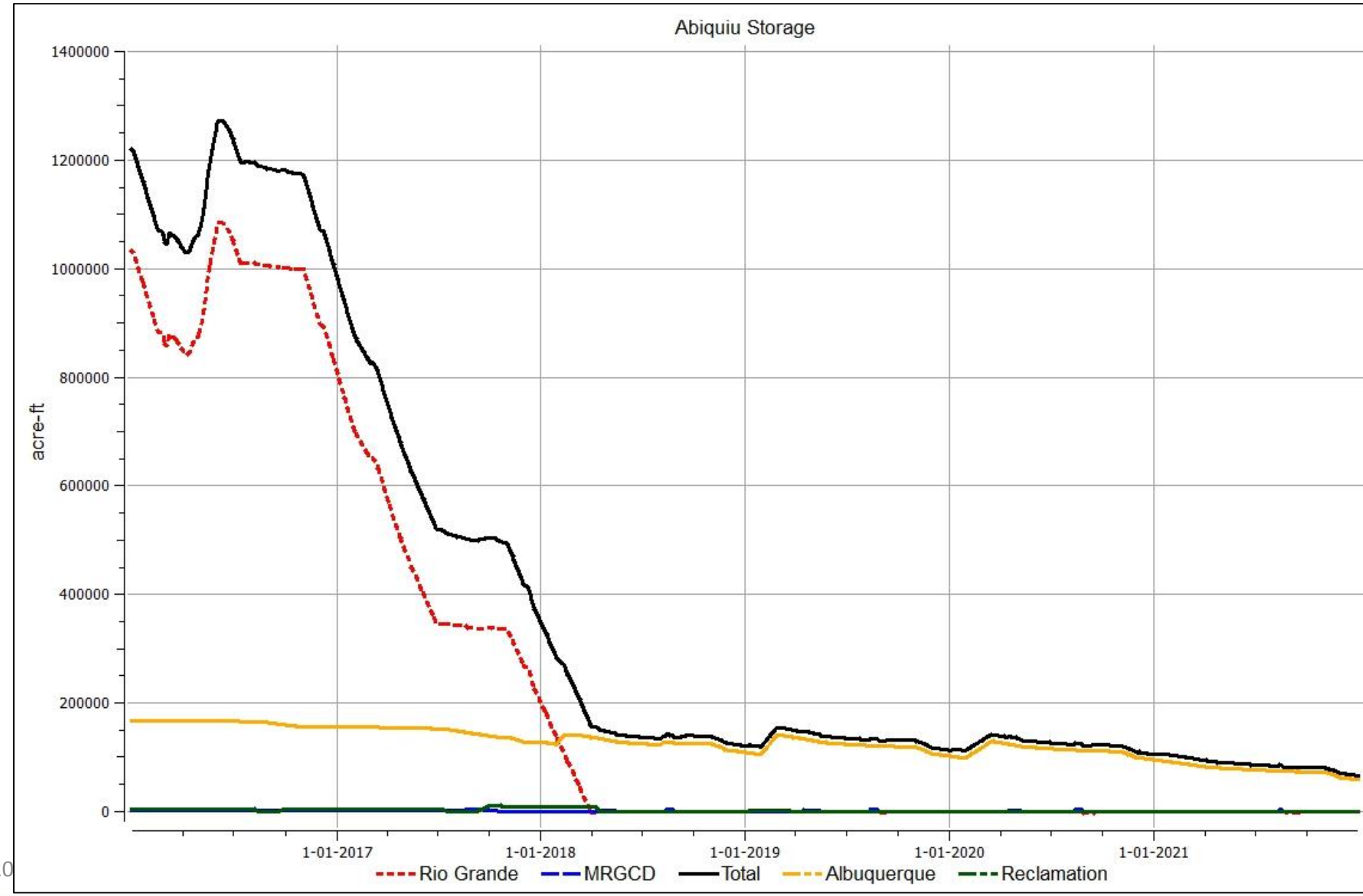


El Vado Storage – Major Accounts – Monthly

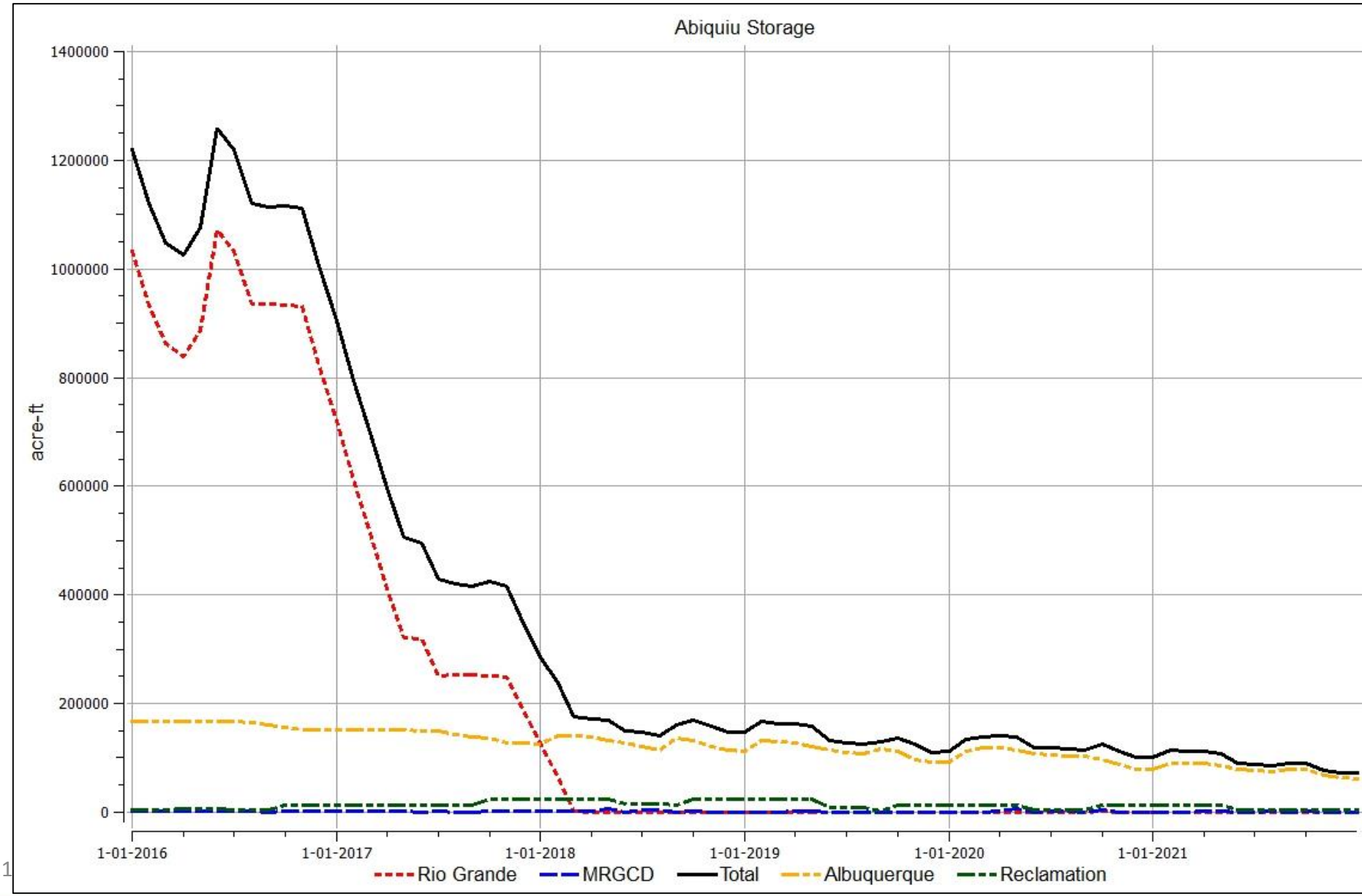



Abiquiu Total Storage
1400
1200
1000
800
600
400
200
0
Storage [kAF]
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021
Simulation Date
Monthly-GeneralizedRules
Daily-GeneralizedRules
Daily-URGWOM_6.6_6-30-15 Rules

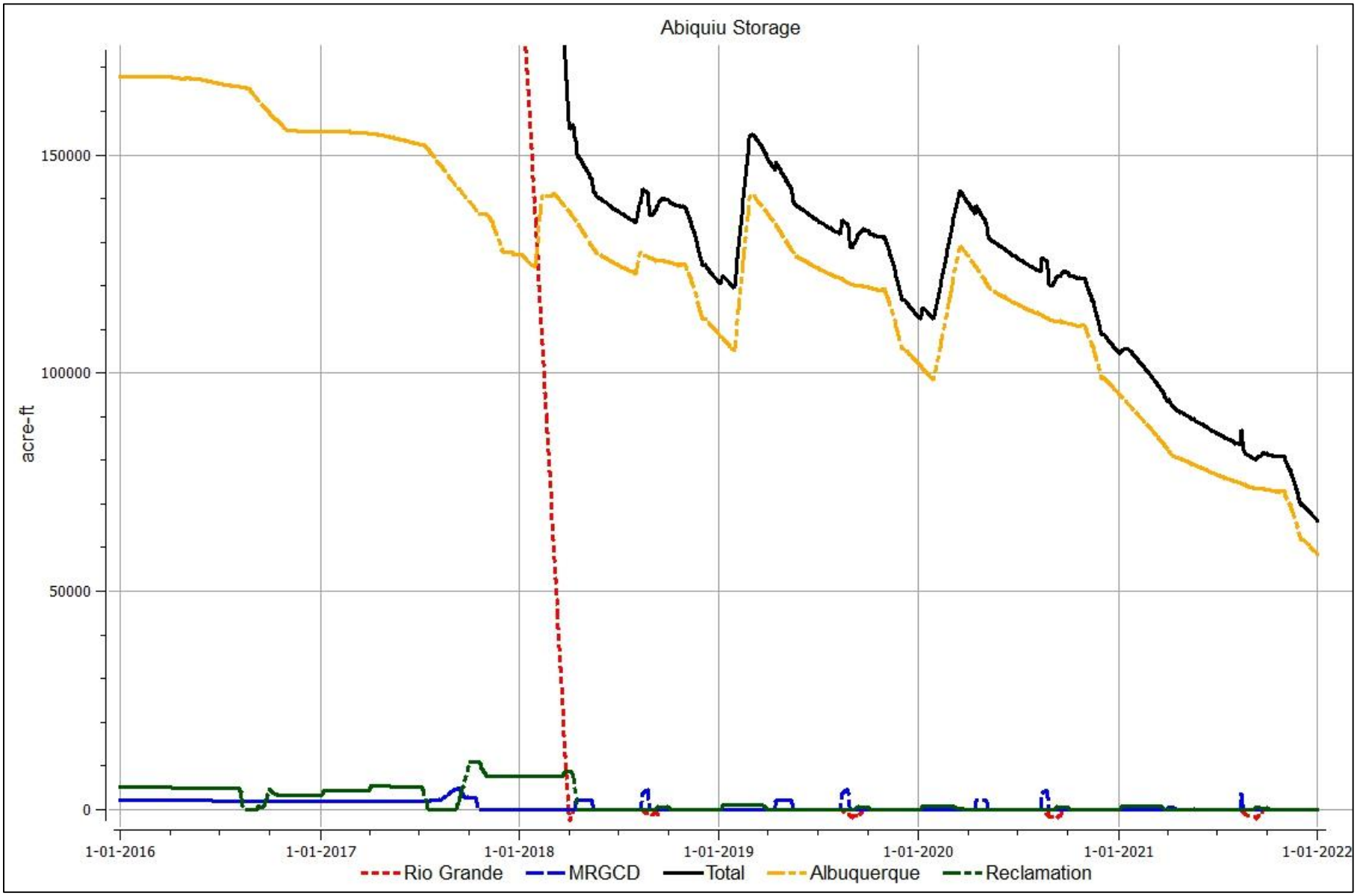
Abiquiu Storage – Major Accounts – Daily



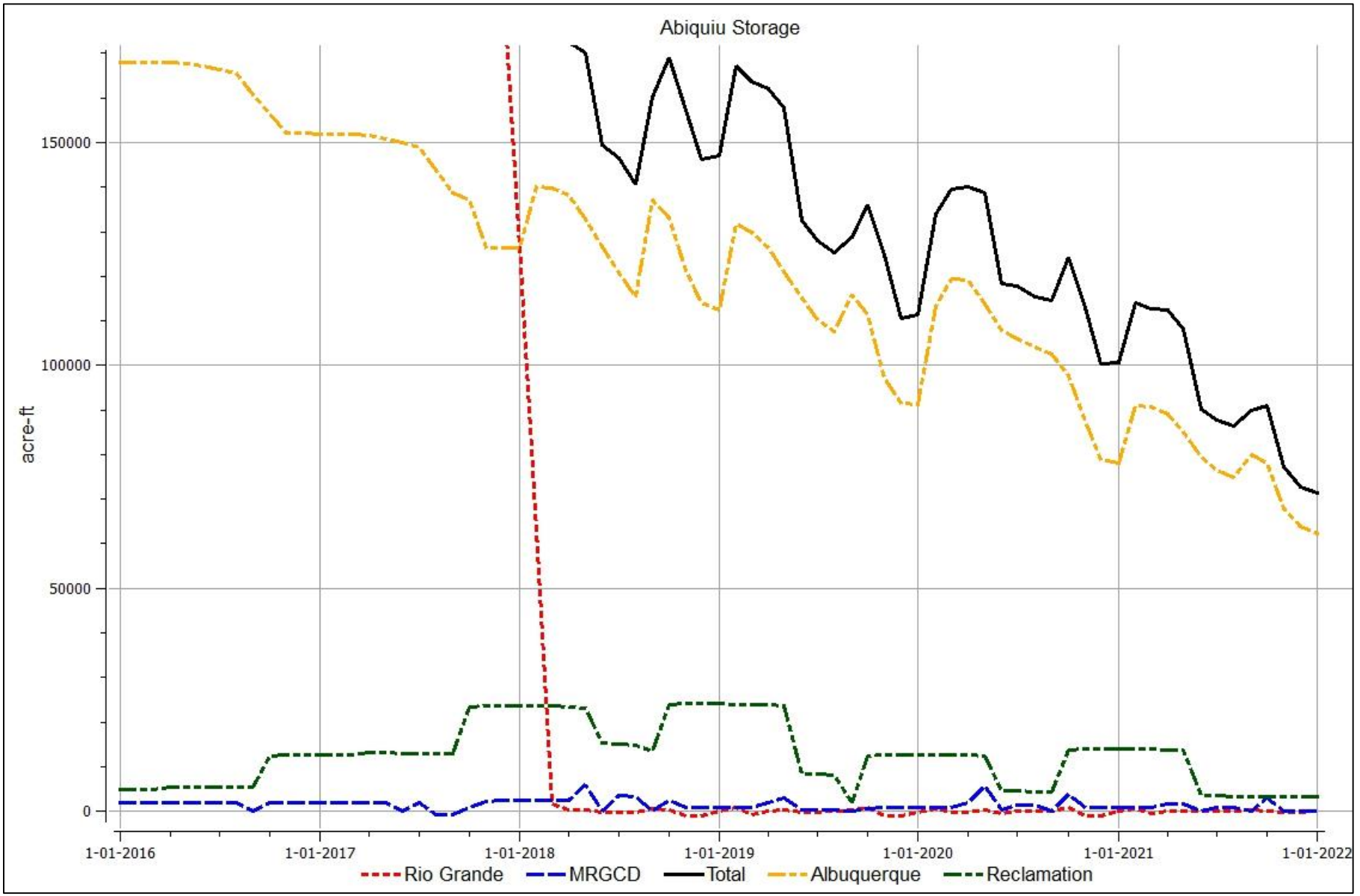
Abiquiu Storage – Major Accounts – Monthly



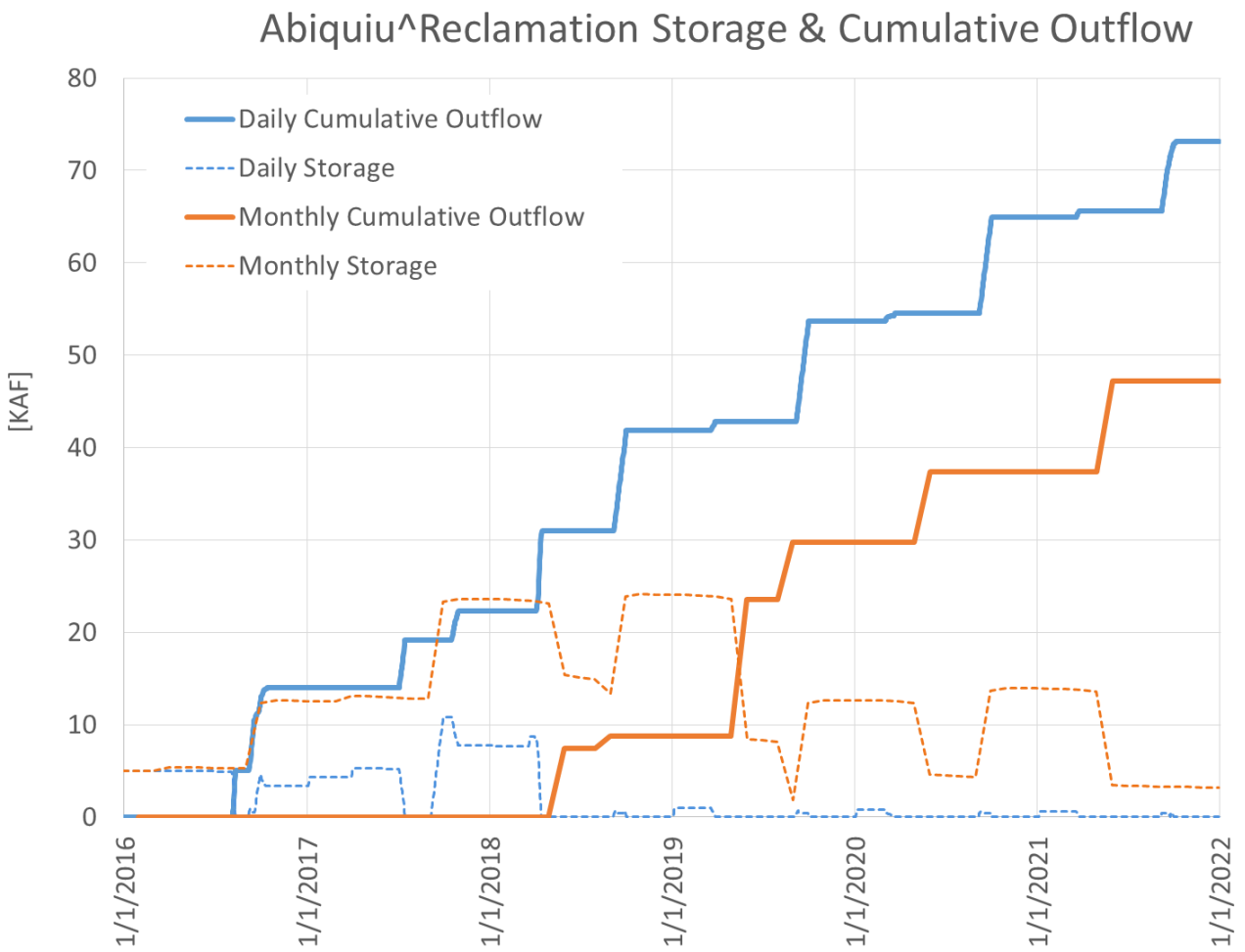
Abiquiu Storage – Major Accounts – Daily: Zoom



Abiquiu Storage – Major Accounts – Monthly: Zoom



Differences in downstream target requirements



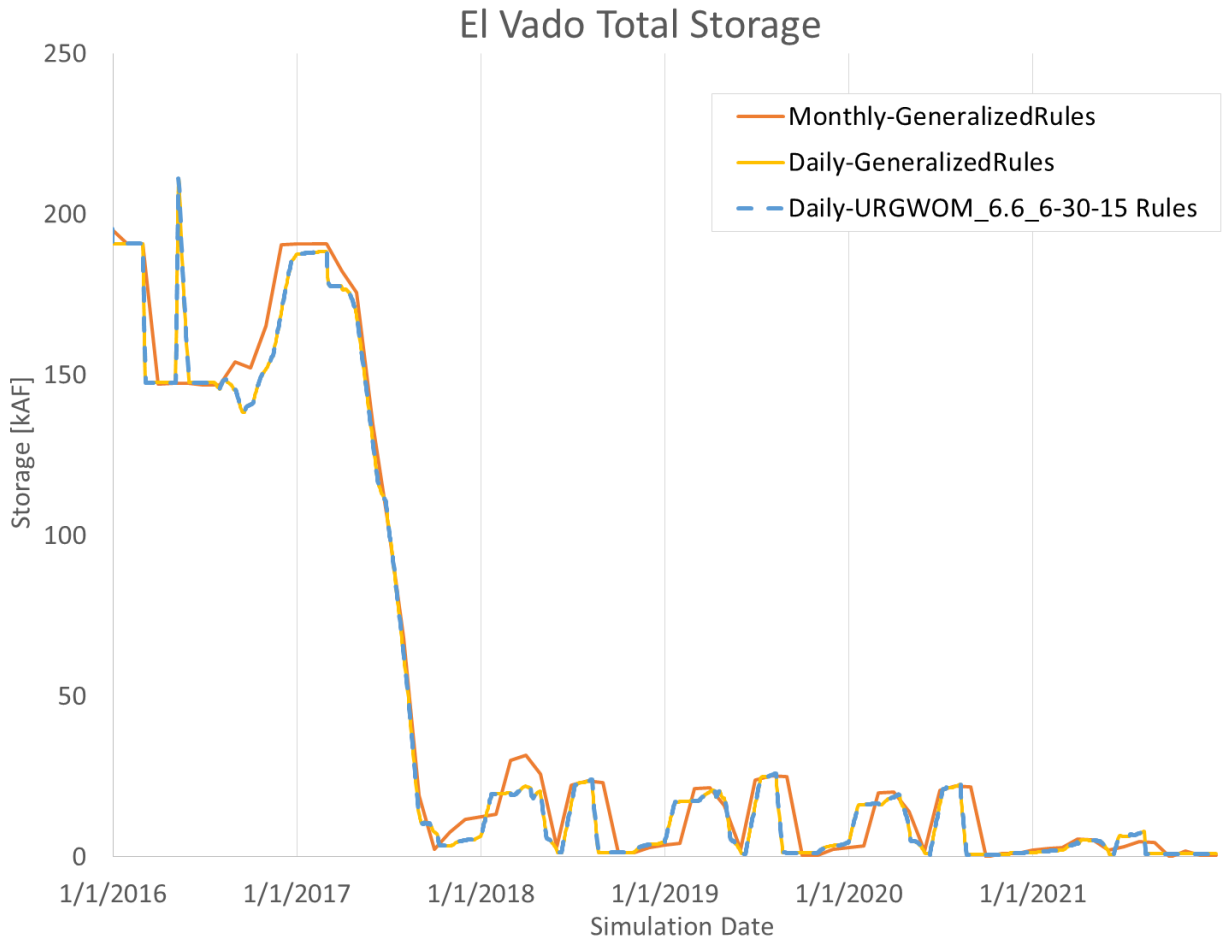
As timestep decreases more volume is typically necessary to meet a given flow target than is necessary at a longer timestep

e.g. Daily water above the target flow doesn't help from daily perspective, but does effectively go towards monthly target volume

Summary

- URGWOM can now run at a daily or monthly timestep
- A timestep generalized ruleset was created from the daily timestep based ruleset
- This generalized ruleset can run the model at a daily or monthly timestep, and for the moment represents a single rule set
- Timestep generalization is not a priority in future ruleset development, so the daily timestep ruleset (default) will diverge from the generalized (monthly) ruleset as development continues

Questions?



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